

# Infective endocarditis in the setting of injection drug use

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## Ibrahim Zardawi MD

Bachelor of Medicine, Bachelor of Surgery (MB ChB)  
University of Baghdad, Iraq, Master of Science in  
Pathology (MSc) University of Baghdad, Iraq, Fellow of  
the Royal College of Pathologists of Great Britain,  
Fellow of the Royal College of Pathologists of  
Australasia, Fellow of the International Academy of  
Cytology, Diploma in Cytopathology, Royal College of  
Pathologists of Australasia, Founding Fellow of the  
Faculty of Science of the Royal College of Pathologists  
of Australasia, Fellow of the College of the American  
Pathologists FCAP, Fellow of the American Association  
of Clinical Pathologists, Diploma of the European  
Board of Pathology



# CLEVELAND CLINIC JOURNAL OF MEDICINE

The causes of vascular insufficiency  
and Hickam vs Ockham

Oral condylomata lata

How do I manage patients with  
thyrotoxicosis until they see  
the endocrinologist?

COMPLETE TABLE OF CONTENTS ON PAGE 709

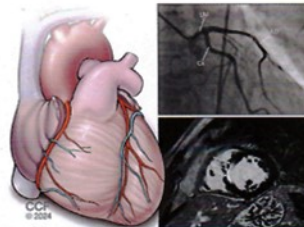
**Prioritizing harm reduction  
in managing infective endocarditis  
associated with injection drug use**

A 74-year-old woman  
with purple toes

Advanced imaging in the diagnosis  
of myocardial infarction without  
obstructive coronary artery disease

Managing urogenital tract  
disorders: 10 urology pearls  
for primary care physicians

Myocardial infarction with  
nonobstructive coronary arteries:  
Current management strategies



The American Heart Association recently issued a scientific statement with suggestions and guiding principles for managing IDU-IE.

The statement emphasizes the need to treat substance use disorder in conjunction with endocarditis.

## Case presentation

### History and examination

39F, HCV+, IV drug user (active IV amphetamine use; on methadone for past heroin addiction)

2-week history of fever, polyarthralgia, SOB and lethargy

Left index finger laceration and infection (3 weeks prior to admission)

Pansystolic murmur, elevated JVP, bibasal crepitations

HR 106, BP 125/50, T 38°C (100.4°F), RR 28, SpO<sub>2</sub> 85% (RA)

### Labs

Pancytopenia (Hb 66, WCC 3.6, Plt 133), high inflammatory markers

### Cultures

Penicillin-sensitive *S. aureus* (blood, urine, finger)

### Echo

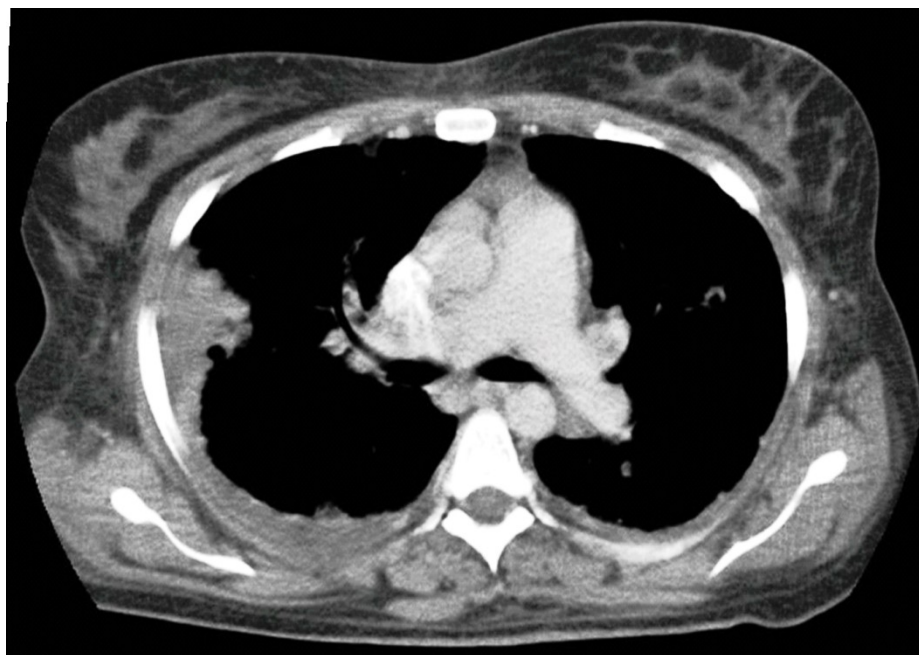
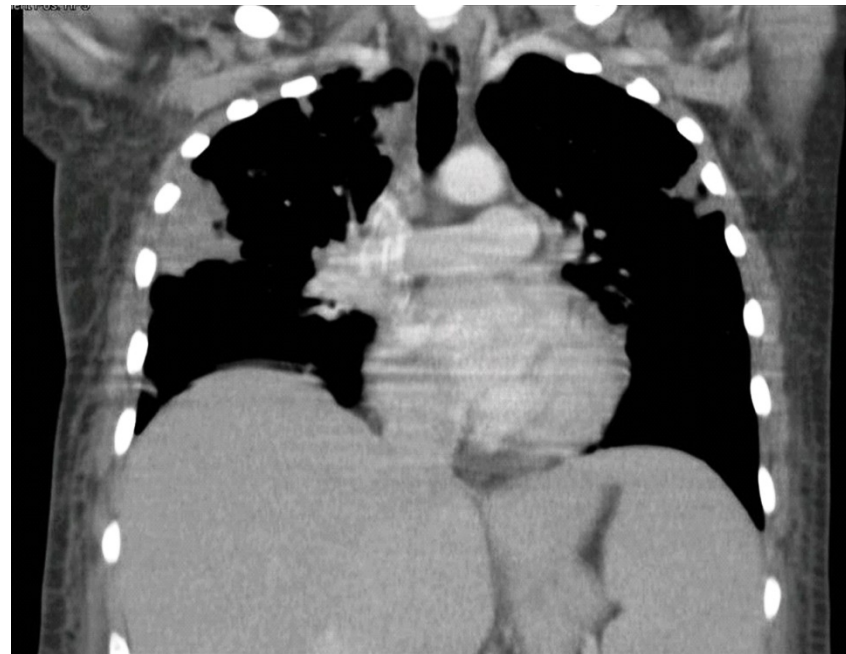
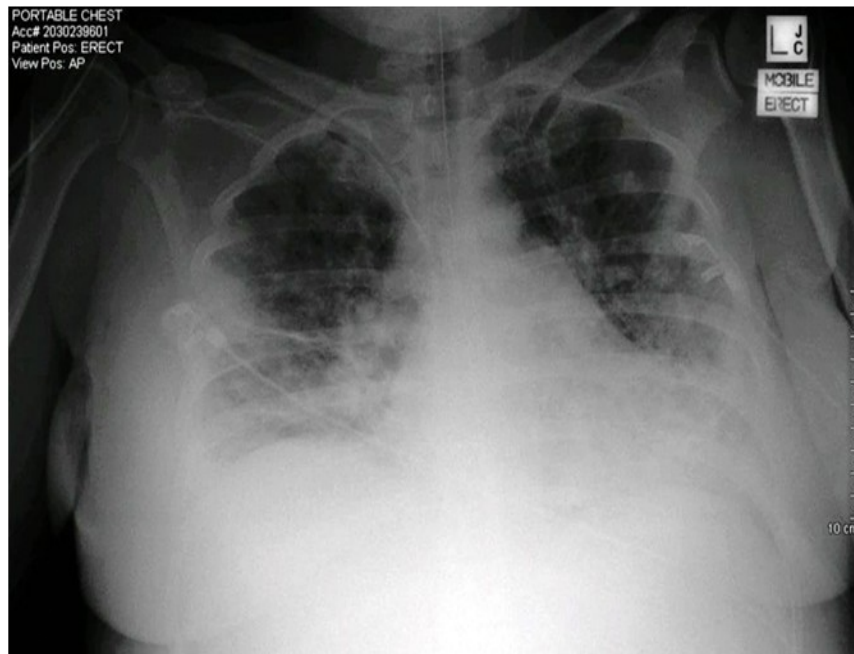
55mm tricuspid vegetation

### Imaging

Bilateral septic pulmonary emboli

### Diagnosis

IVDU-associated *S. aureus* tricuspid endocarditis originating from infected finger wound with septic emboli



## Management Plan

### Antibiotic Therapy:

Intravenous flucloxacillin for Staphylococcus aureus endocarditis

### Supportive Care:

Oxygen therapy, hydration and anemia management

### Surgical Consultation:

Evaluate for tricuspid valve vegetation removal

### Addiction Support:

Methadone maintenance and referral to addiction services

### Hepatitis C Management:

Referral to hepatology for antiviral therapy



## **Surgical Intervention**

Underwent vegetectomy of the tricuspid valve.

## **Follow-Up and Outcomes**

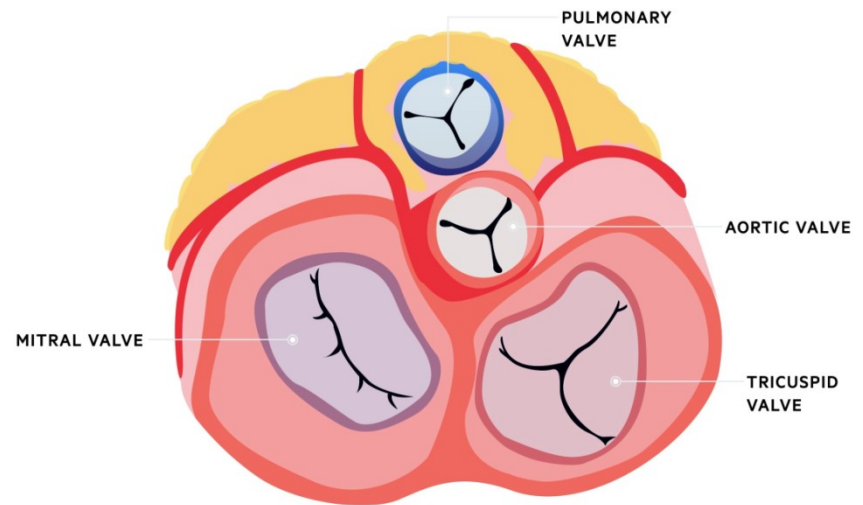
Completed six weeks of IV penicillin under the "Out and About" home treatment program.

No signs of tricuspid valve incompetence on follow-up and no further IV drug use.



# Overview of infective endocarditis

- Epidemiological aspects
- Predisposing factors
- Pathogenesis and patholog
- Microbiological features
- Clinical manifestations
- Diagnostic criteria
- Treatment options
- Complications
- Trends
- Mortality and relapse

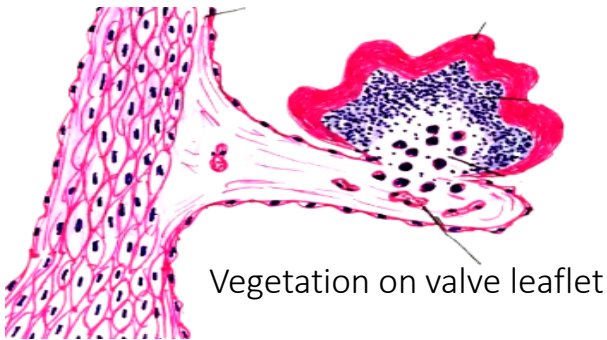


## Endocarditis

- Inflammation of endocardium
- Valvular or mural
- Infective or non-infective
- Endocardial **vegetations**





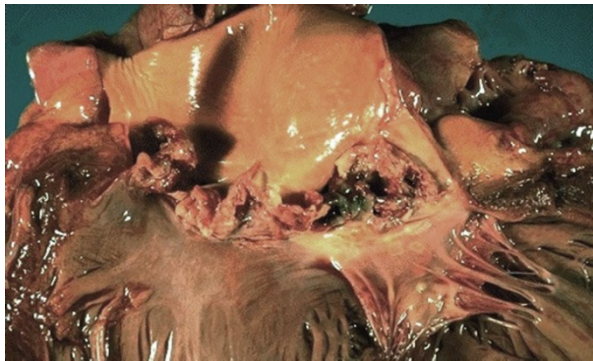


Vegetation on valve leaflet

## Vegetations

Mass of fibrin, thrombotic debris, inflammatory cells and organisms (bacteria or other organisms)

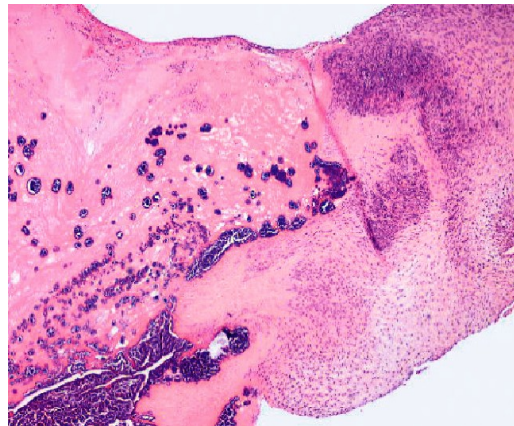
Organisms within the vegetation are encased by a **physical barrier** (platelet and fibrin), shielding them from the **immune response** of the host and the administered **antibiotics**.



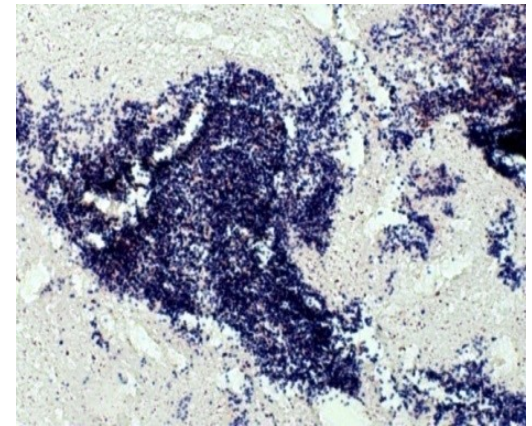
Ulcerated vegetation



Vegetation



Fibrin, debris, WBCs & bacteria



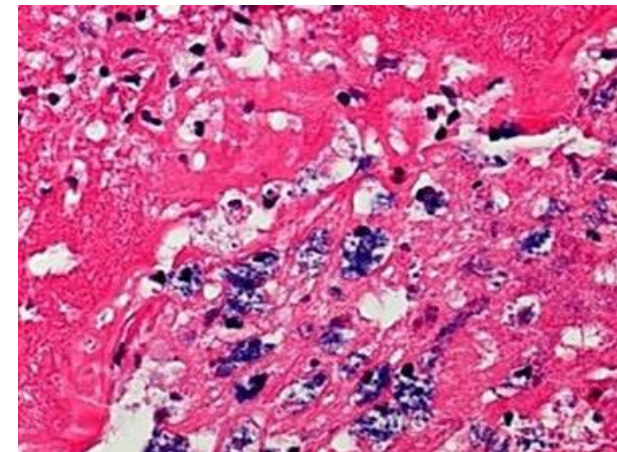
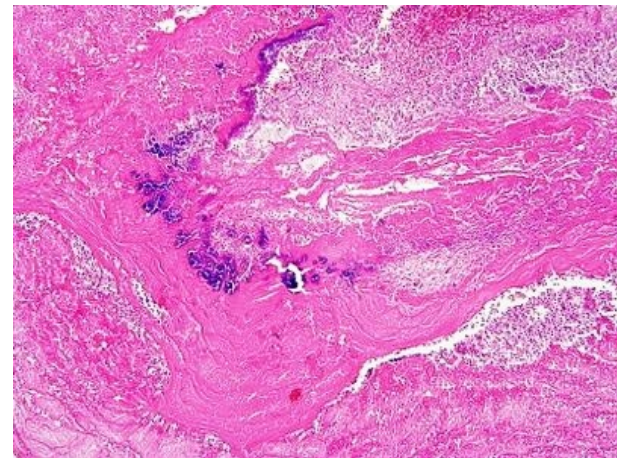
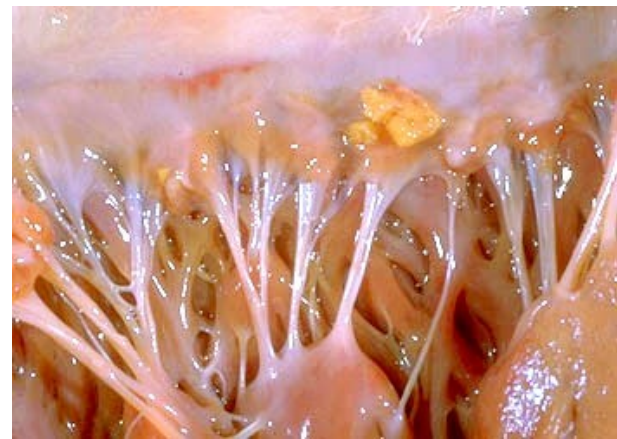
Gram positive cocci

# Pathogenesis of vegetation in infective endocarditis

1. **Sterile nidus** composed of platelets and fibrin form on damaged valvular endothelium

2. **Colonization of the nidus** by micro-organisms circulating in the bloodstream

3. **Microbial growth in the nidus** results in further accumulation of more platelets and fibrin, until a **vegetation** (macroscopic excrescence) is formed



## Pathogenesis of vegetations

### 1. Endothelial damage

Valvular or mural endothelial damage creates a site for bacterial attachment

### 2. Platelet and fibrin deposition

Platelets and fibrin form a sterile lesion called a vegetation

### 3. Microbial attachment

Micro-organisms from the bloodstream adhere to the vegetation

### 4. Rapid microbial multiplication

Micro-organisms multiply rapidly in the protected area of the vegetation

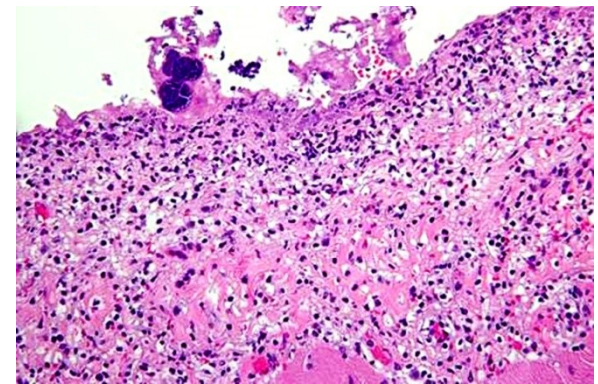
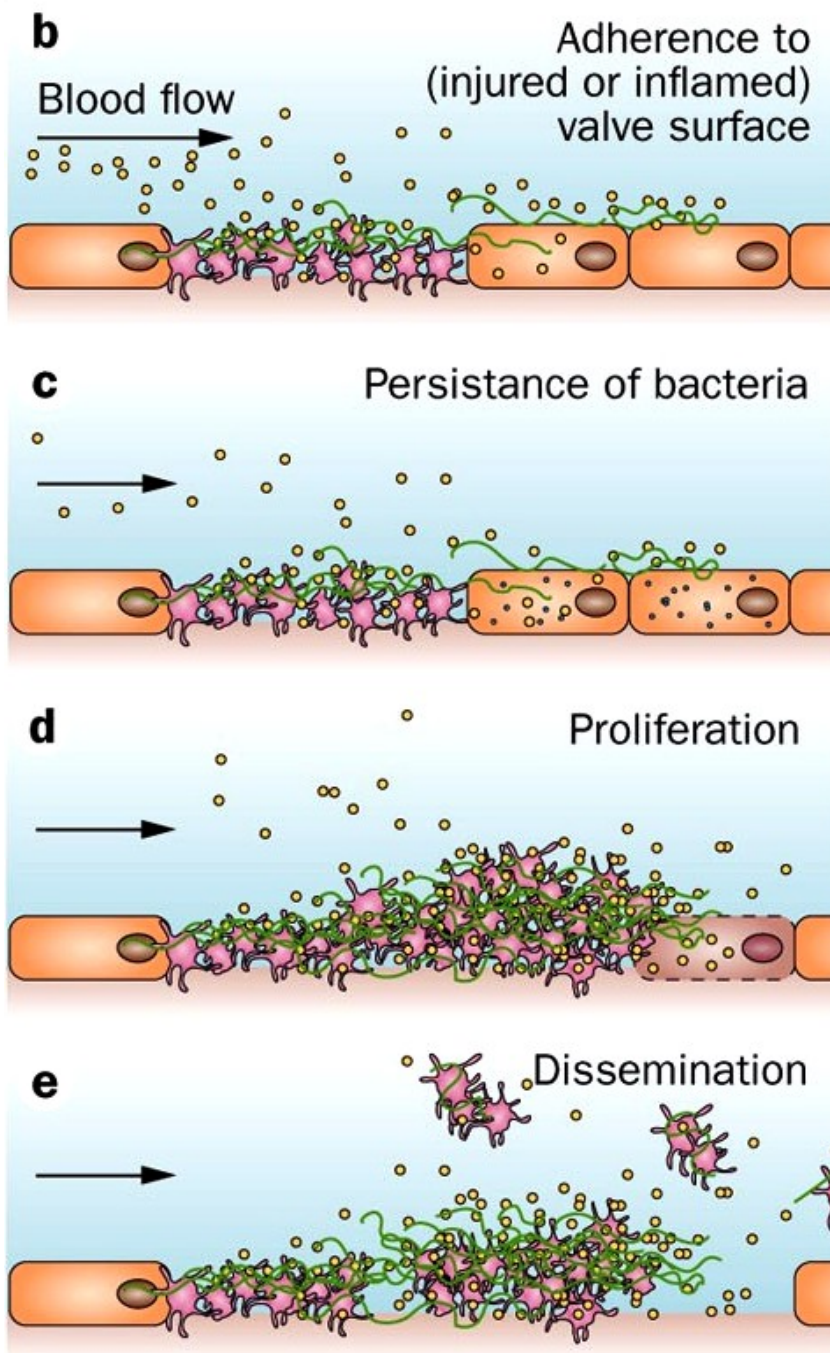
### 5. Vegetation growth

Vegetation grows as a macroscopic excrescence

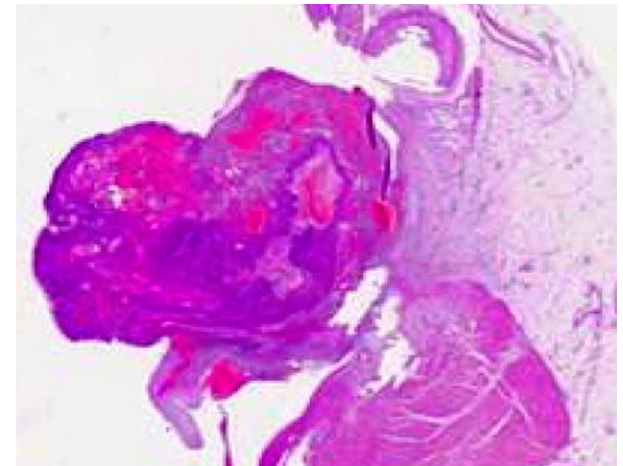
### 6. Vegetation detachment

Embolization, infarction, abscess formation, mycotic aneurysms, etc

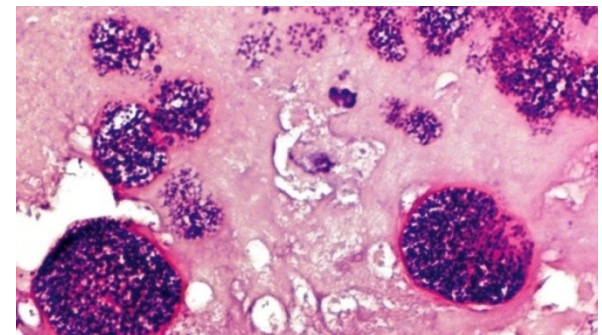




Bacterial colonies and inflammatory material



Vegetation (fibrin, blood cells, bacteria)



Bacterial microcolonies and thrombotic debris

## Pathogenesis of infective endocarditis

### ➤ Endocardial injury

Normal endocardium is **resistant** to infection with most bacteria or fungi

Highly **virulent** organisms such as **Staphylococcus aureus** are capable of infecting normal heart valves

Initial step is **injury** to the endocardium, followed by **focal adherence of platelets and fibrin**

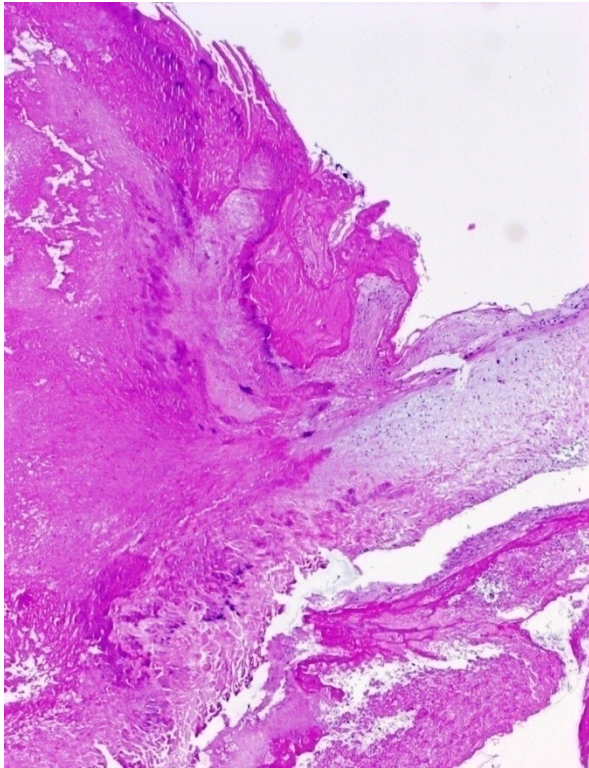
### ➤ Microbial adherence

Adherence, an early event in the pathogenesis of endocarditis, is aided by **Dextran** which is bacteria produced adhesive that helps organisms **adhere to fibrin and platelets**

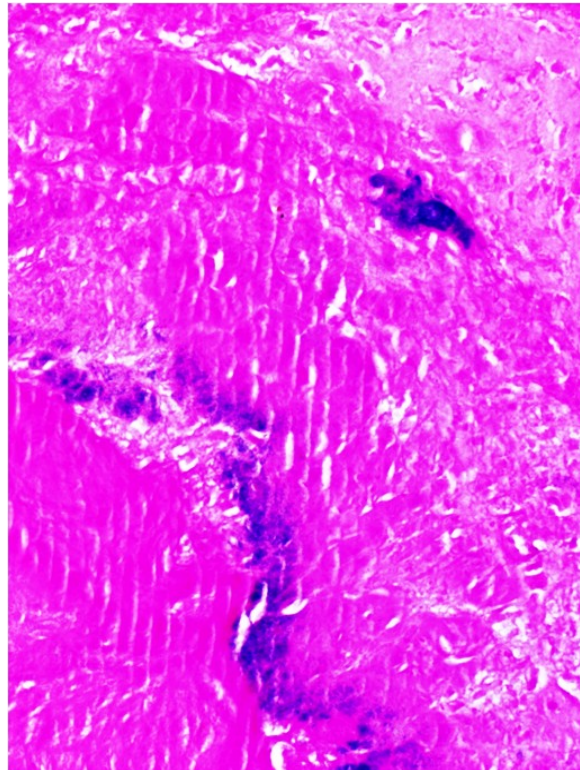
**Intrinsic binding affinity of the organism to ground substance** is also important in bacterial adherence



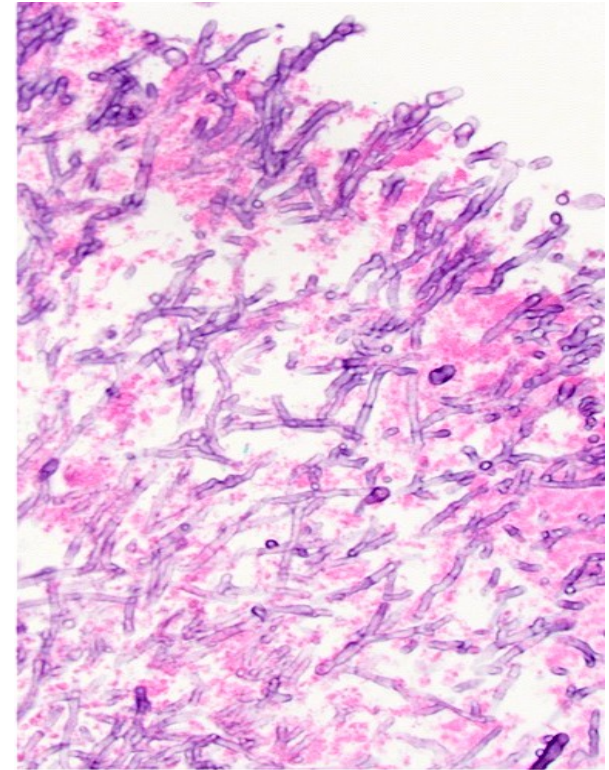
# Vegetations



Eosinophilic debris, fibrin and basophilic bacteria on damaged valve leaflet



Eosinophilic debris, fibrin and basophilic bacterial microcolonies



Eosinophilic debris, fibrin and fungal hyphal elements extending into underlying myocardium

Debris, fibrin and inflammatory material (eosinophilic) with bacterial microcolonies (basophilic) are the main constituents of the vegetation

## Types of vegetation

### Rheumatic heart disease

Row of small vegetations along lines of closure

### Infective endocarditis

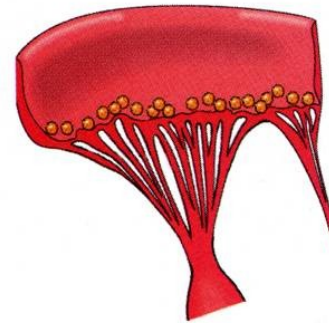
Large irregular masses on cusps  
Extension onto chordae

### Non-bacterial thrombotic endocarditis

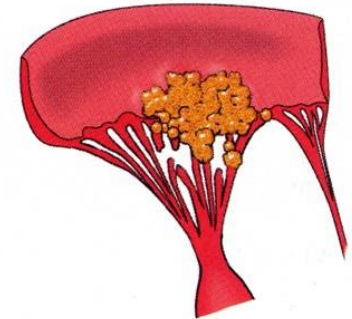
Small vegetations at lines of closure

### Libman-Sacks endocarditis

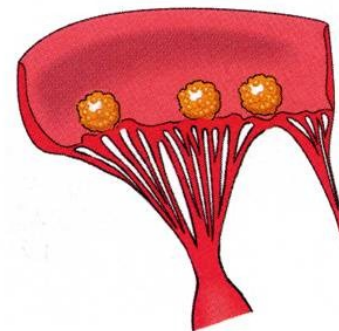
Small to medium sized vegetations  
on either or both sides of leaflets  
seen in SLE



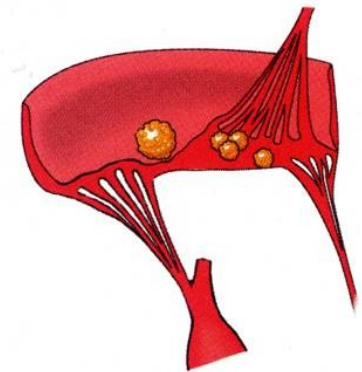
RHD



IE



NBTE



LSE

## Non-bacterial thrombotic endocarditis (NBTE) Marantic endocarditis

**Small** vegetations on previously normal valves

Fibrin and other blood elements

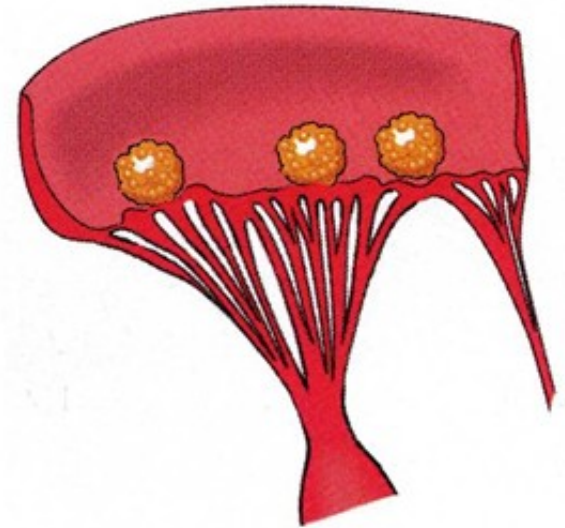
Valve leaflets at **lines of closure**

Vegetations are **sterile** with no organisms

Seen in **debilitated patients** (cancer or sepsis)

Local effects from vegetations are **unimportant or negligible**

May lead to **embolization and infarction**



NBTE

Libman-Sacks endocarditis (LSE)

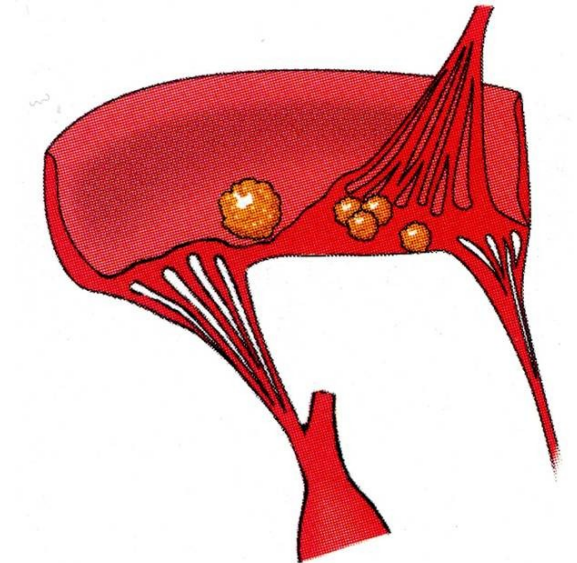
SLE/Antiphospholipid syndrome

Small sterile vegetations (fibrin,  
necrotic material)

Associated vasculitis

Vegetations can be seen on **both**  
**surfaces of the AV valves**

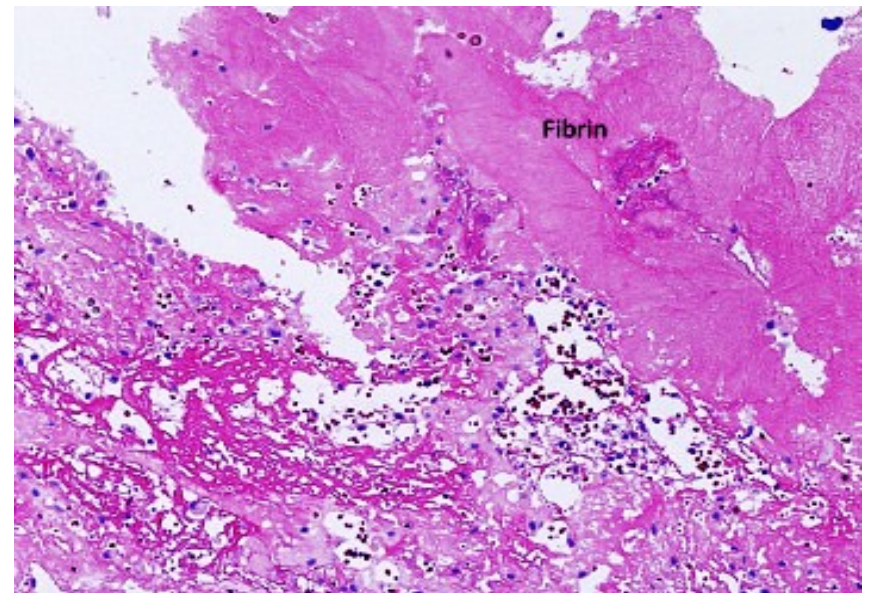
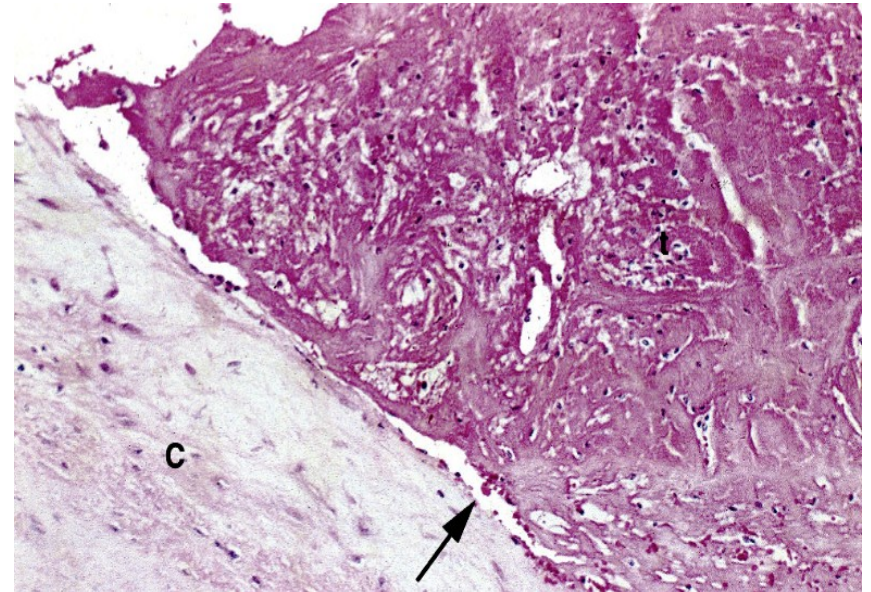
Mitral or tricuspid **regurgitation**  
**and valvular deformity**



LSE



## Non-bacterial thrombotic endocarditis (Fibrin and other blood elements)



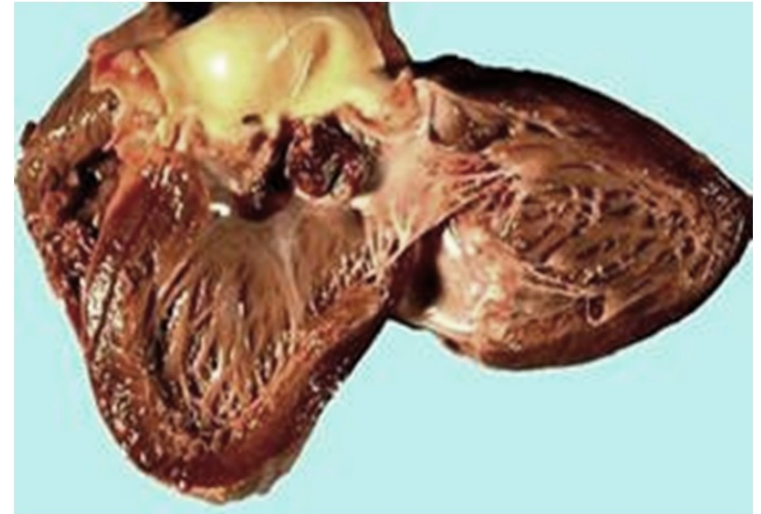
## Libman-Sacks endocarditis (Fibrin, necrotic material and degenerate blood cells)



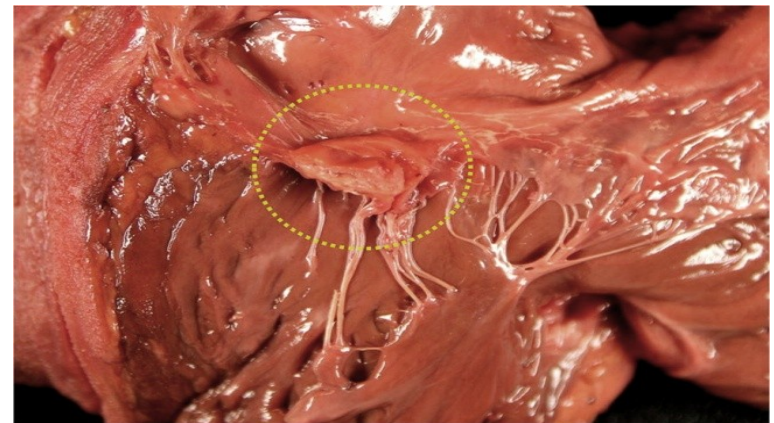
Classification of infective endocarditis  
IE can be **acute or subacute**

Clinical classification of IE is based on

- **Severity and tempo of disease**
- **Virulence of the infecting organisms**
- **Underlying cardiac disease**



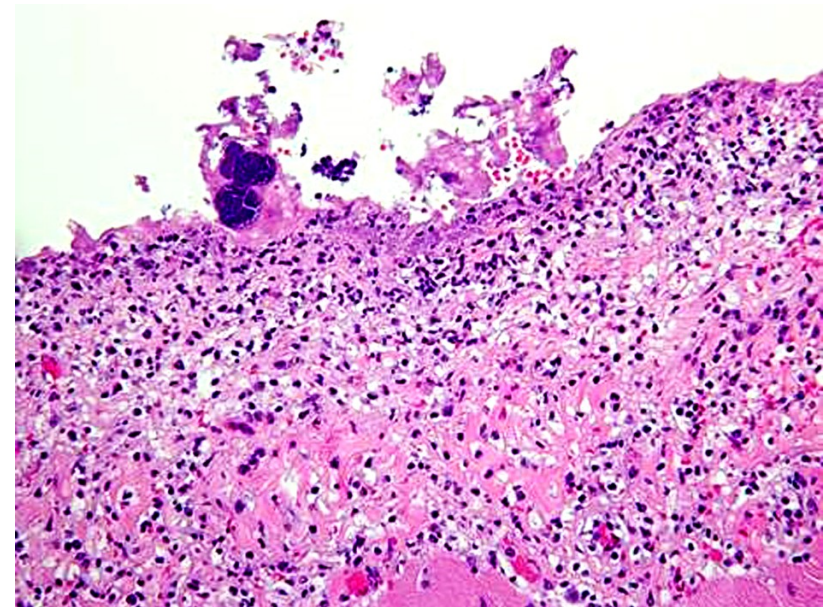
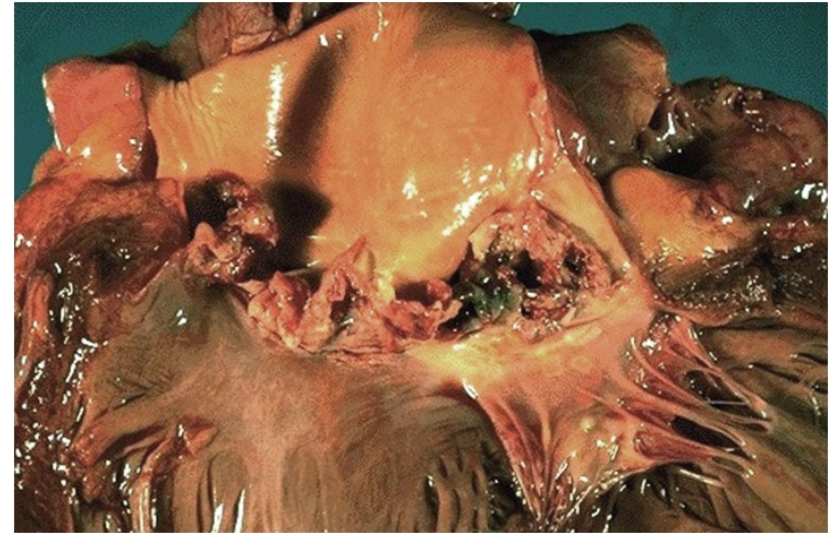
Acute bacterial endocarditis  
(vegetation on aortic valve)



Subacute bacterial endocarditis  
(vegetation on tricuspid valve)

## Acute infective endocarditis

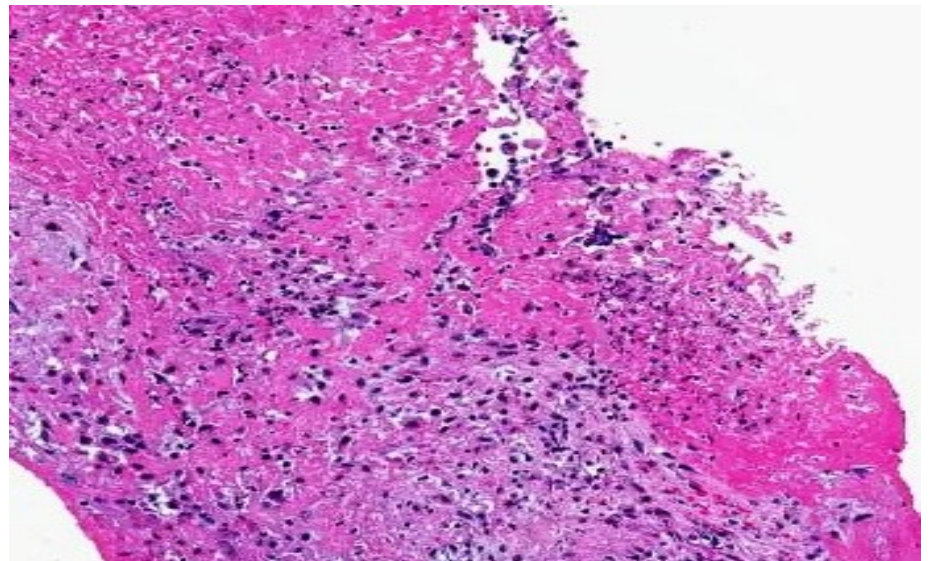
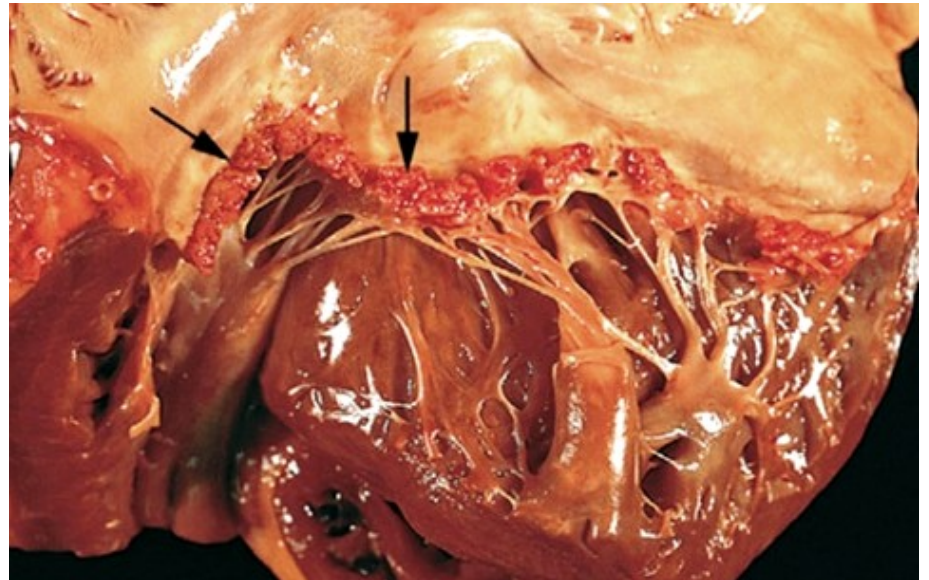
- Destructive infection of previously normal or damaged valves
- Caused by highly virulent organisms (Staph aureus)
- Necrotising, ulcerative massive valvular vegetations
- Associated with severe symptoms and high mortality despite antibiotics and surgery





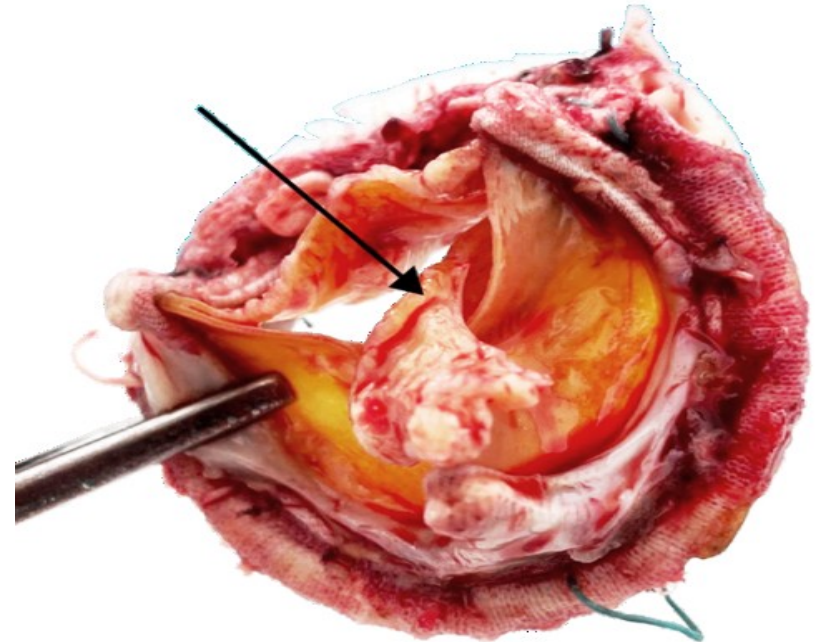
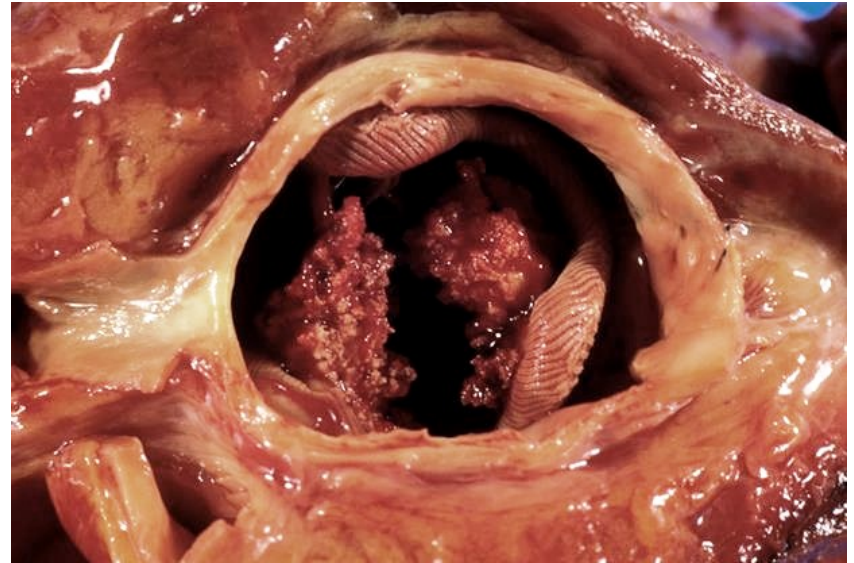
## Subacute infective endocarditis

- Appears insidiously
- Occurs in previously damaged heart valves
- Caused by organisms of low virulence (*Strep viridans*)
- Has a protracted clinical course
- Less valvular destruction
- Most recover with antibiotic therapy



## Prosthetic valvular endocarditis (PVE)

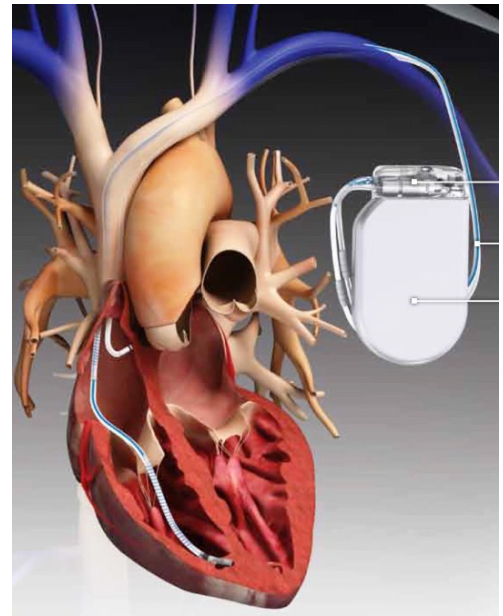
- PVE develops in **1% of patients** after valve replacement each year
- More common with **aortic** than mitral valve prostheses
- Least common with **porcine valves (heterografts)**
- Caused by **bacterial contamination** at time of surgery or by transient asymptomatic **bacteraemia**



## Pacemaker-endocarditis

Caused by organisms introduced at the time of surgery or those that usually migrate across a **broken skin barrier**, from an eroding battery pack or generator pocket wound

**Early** infections are frequently due to **Staph aureus**, and **late** infections to **Staph epidermidis**





## Portal of entry of micro-organisms

- An **obvious infection** elsewhere
- **Dental or surgical procedures** that cause transient bacteraemia
- **Injection** of contaminated material directly into the bloodstream by **intravenous drug users**
- **Occult** source from the gut, oral cavity or trivial injuries

## Clinical diagnosis of IE

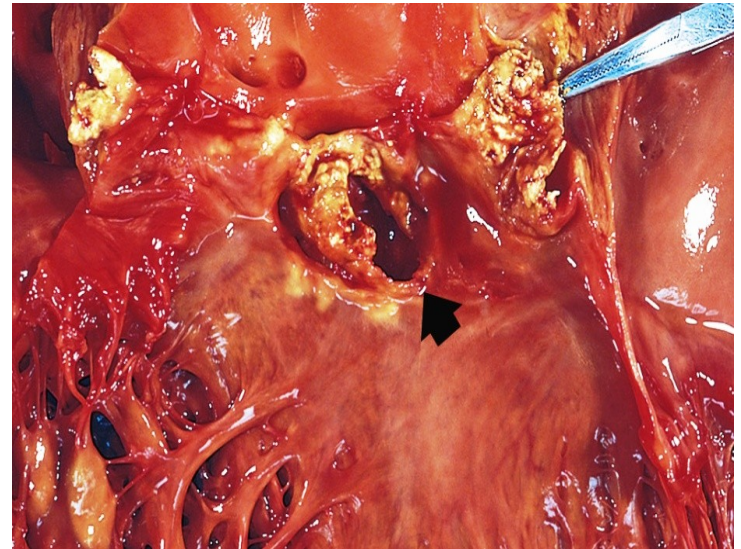
- Fever (absent in 15%)
- Murmur (present in 90%)
- Risk factors
- Embolic events
- Petechiae

## Clinical manifestation of IE

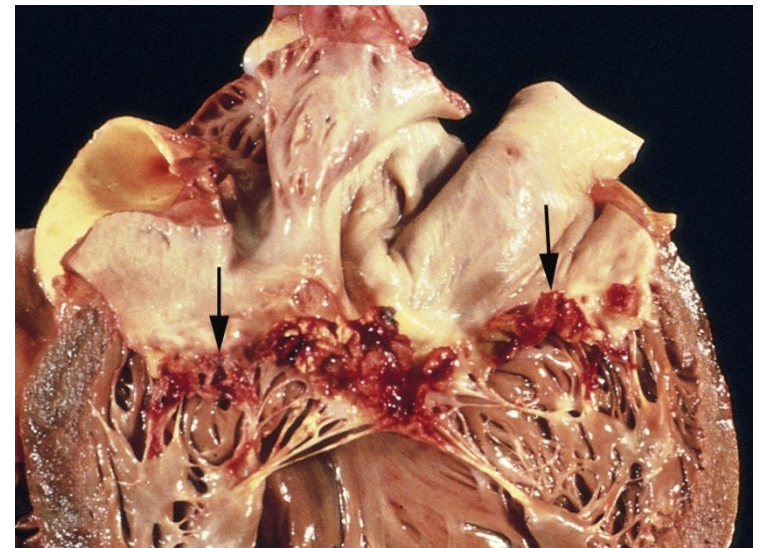
- Systemic infection
- Cardiac involvement (valvular or myocardial damage)
- Embolic phenomena
- Immune-mediated injury

## Main cardiac complications of IE

- Valvular damage
- Myocardial abscess formation
- Mycotic aneurysms



Acute endocarditis of bicuspid aortic valve (*Staphylococcus aureus*)



Subacute endocarditis of mitral valve (*Streptococcus viridans*)

## Splinter or subungual hemorrhages

Thin, red, linear or flame-shaped streaks located within the **nail beds**.

## Janeway lesions

Small, non-tender embolic erythematous or hemorrhagic macular lesions on the **palms and soles**.

## Osler nodes

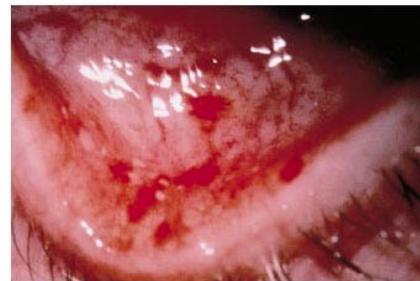
Painful, tender **subcutaneous nodules** that typically appear on the pulp of the digits or on the more proximal aspects of the fingers. They persist for hours to days.

## Roth spots

Oval-shaped **retinal hemorrhages** with pale centers.



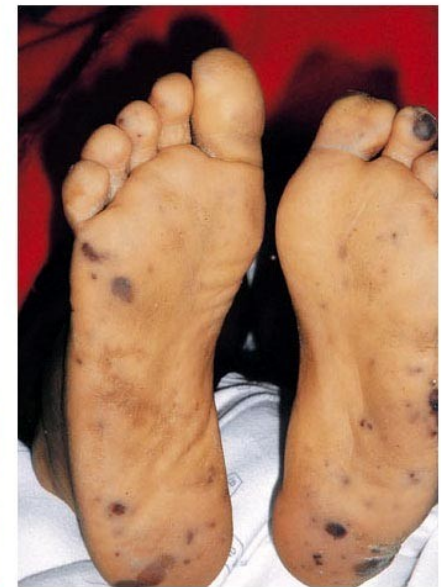
A



B



C



D

# Clinical, Microbiological, and Imaging Characteristics of Infective Endocarditis in Latin America: A Systematic Review based on 44 studies

Urina-Jassir, et al. International Journal of Infectious Diseases 2022

Variable	Studies	n/N (%)
<b>Fever</b>	<b>22</b>	<b>2109/2513 (83.9%)</b>
Dyspnea	5	303/820 (37.0%)
Heart failure	28	1108/3047 (36.4%)
Malaise	7	312/494 (63.2%)
<b>Heart murmur</b>	<b>14</b>	<b>1119/1940 (57.7%)</b>
Immunological phenomena	11	206/1851 (11.1%)
Osler's nodes	8	59/1536 (3.8%)
Roth's spots	5	46/1296 (3.6%)
Positive RF	4	23/583 (4.0%)
<b>Glomerulonephritis</b>	<b>2</b>	<b>60/297 (20.2%)</b>

n is the total number of cases with that variable, N is the total number of cases of the studies reporting that variable

# Clinical, Microbiological, and Imaging Characteristics of Infective Endocarditis in Latin America: A Systematic Review

Urina-Jassir, et al. International Journal of Infectious Diseases 2022

Variable	Studies	n/N (%)
<b>Vascular phenomena</b>	<b>34</b>	<b>1076/3559 (30.2%)</b>
<b>Embolism</b>	<b>33</b>	<b>944/3483 (27.1%)</b>
Mycotic aneurysm	7	46/1433 (3.2%)
Janeway lesions	7	44/1170 (3.8%)
Conjunctival hemorrhages	4	22/315 (7.0%)
Hemorrhagic stroke	2	6/119 (5.0%)
<b>Other manifestations</b>		
Ungual or splinter hemorrhages	6	84/987 (8.5%)
<b>Sepsis</b>	<b>7</b>	<b>619/2815 (69.7%)</b>
<b>Splenomegaly</b>	<b>8</b>	<b>279/1137 (24.5%)</b>
<b>Petechiae</b>	<b>7</b>	<b>291/1400 (20.8%)</b>
<b>Hepatomegaly</b>	<b>4</b>	<b>223/783 (28.5%)</b>

n is the total number of cases with that variable, N is the total number of cases of the studies reporting that variable



**Table 1. The Duke Criteria for the Clinical Diagnosis of Infectious Endocarditis**

**Major criteria**

- Positive blood culture
  - Two separate blood cultures positive for microorganism consistent with infectious endocarditis (viridans *Streptococcus*, *Streptococcus bovis*, gram-negative HACEK bacilli, *Staphylococcus aureus*, or community-acquired enterococci in the absence of a primary focus)
  - or
  - Recovery of a microorganism consistent with infectious endocarditis from blood cultures drawn more than 12 hours apart
  - or
  - Recovery of a microorganism consistent with infectious endocarditis from all of three or most of four or more blood cultures, with first and last drawn more than one hour apart
  - or
  - Single positive blood culture for *Coxiella burnetii* or phase 1 immunoglobulin G antibody titer greater than 1:800
- Evidence of endocardial involvement
  - Positive echocardiography (oscillating intracardiac mass on valve or supporting structures, or in the path of regurgitant jets, or on implanted material in the absence of an alternative anatomic explanation; intracardiac abscess; new partial dehiscence of prosthetic valve)
  - New valvular regurgitation (increase or change in preexisting murmur not sufficient)

**Minor criteria**

- Fever of at least 38.0°C (100.4°F)
- Immunologic phenomena: glomerulonephritis, Osler nodes, Roth spots, rheumatoid factor
- Microbiologic evidence: positive blood culture that does not meet major criteria, serologic evidence of active infection with organism consistent with infectious endocarditis
- Predisposing heart condition or history of injection drug use
- Vascular phenomena: major arterial emboli, septic pulmonary infarctions, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhages, Janeway lesions

**Duke Criteria were published in 1994**

2 major criteria or 1 major criterion and 3 minor criteria

**Modified in 2000**

**Updated modified Duke criteria 2023**

**Table 34.3.** The Modified Duke Criteria for the Diagnosis of Endocarditis

### Major Criteria

- • Blood culture positive for IE
  - Typical microorganisms consistent with IE from two separate blood cultures
    - Viridans streptococci; *Streptococcus bovis*, HACEK group, *Staphylococcus aureus*; or
    - Community-acquired enterococci, in the absence of a primary focus
  - Microorganisms consistent with IE from persistently positive blood cultures, defined as follows:
    - At least two positive blood cultures of blood samples drawn >12 h apart; or
    - All of three or a majority of  $\geq 4$  separate cultures of blood (with first and last sample drawn at least 1 h apart)
  - Single positive blood culture for *Coxiella burnetii* or antiphase I IgG antibody titer >1:800
- • Evidence of endocardial involvement
- • Echocardiogram positive for IE (TEE recommended in patients with prosthetic valves, rated at least “possible IE” by clinical criteria, or complicated IE [paravalvular abscess]; TTE as first test in other patients), defined as follows:
  - Oscillating intracardiac mass on valve or supporting structures, in the path of regurgitant jets, or on implanted material in the absence of an alternative anatomic explanation; or
  - Abscess; or
  - New partial dehiscence of prosthetic valve
- • New valvular regurgitation (worsening or changing or preexisting murmur not sufficient)

### Minor Criteria

- • Predisposition, predisposing heart condition or injection drug use
- Fever, temperature  $>38^{\circ}\text{C}$
- Vascular phenomena, major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhages, and Janeway lesions
- Immunologic phenomena: Glomerulonephritis, Osler nodes, Roth’s spots, and rheumatoid factor
- Microbiological evidence: Positive blood culture but does not meet a major criterion as noted previously (excluding single positive cultures for coagulase-negative staphylococci and organisms that do not cause endocarditis) or serologic evidence of active infection with organisms consistent with IE
- • Echocardiographic minor criteria eliminated

# The 2023 Duke-International Society for Cardiovascular Infectious Diseases Criteria for Infective Endocarditis: Updated Modified Duke Criteria

## I. Definite endocarditis

### A. Pathologic criteria

1. Microorganisms identified in the context of clinical signs of active endocarditis in a vegetation or from an arterial embolus  
or
2. Active endocarditis identified in or on a vegetation or from an arterial embolus

### B. Clinical criteria

2 major criteria or 1 major criterion and 3 minor criteria or 5 minor criteria

## II. Possible endocarditis

1 major criterion and 1 minor criterion or 3 minor criteria

## III. Rejected endocarditis

Firm alternate diagnosis

Lack of recurrence despite antibiotic therapy for less than 4 days

No pathological or macroscopic evidence of IE at surgery or autopsy, with antibiotic therapy for less than 4 days

Does not meet criteria for possible IE



# Definitions according to the 2023 Duke-International Society for Cardiovascular Infectious Diseases Infective Endocarditis Criteria for the Diagnosis of IE

## I. Major criteria

### A. Microbiologic major criteria

1. Positive blood cultures
2. Positive laboratory tests PCR, Serology, IF

### B. Imaging major criteria (Echo, CT, PET)

### C. Surgical major criteria

## II. Minor criteria

### A. Predisposition

### B. Fever documented temperature greater than 38.0 °C (100.4 °F)

### C. Vascular phenomena

### D. Immunologic phenomena

### E. Microbiologic evidence

### F. Imaging criteria

### G. Physical examination criteria

## Demographics of infective endocarditis

IE is difficult to diagnose and is associated with a high death rate (25%)

Incidence is much higher in patients with underlying valvular heart disease and IV drug users

Incidence of IE is about 3-4 cases per 100,000 population per year which has been slightly increasing over the past 3 decades

Longer survival

- Degenerative heart diseases

- Prosthetic heart valves

- Congenital heart disease

Advances in medical and surgical treatments

More sensitive and specific diagnosis

## Predisposing factors to IE in Latin America Variable Studies (2022)

Variable	Number with variable/total number	Percentage positivity
Previous valve disease	451/1853	24.3%
Prosthetic valve	603/2573	23.4%
Previous rheumatic heart disease	269/2005	13.4%
Congenital heart diseased	289/2964	9.8%
Previous IE	233/2647	8.8%
Previous heart failure	272/1178	23.1%
→ IV drug use	79/1981	4%
Indwelling catheter or device	264/1261	20.9%
Previous surgical procedure	326/1491	21.9%
Previous dental procedure	48/856	5.6%



## Endocarditis in native and Prosthetic valves

### Native valve endocarditis (NVE)

#### Underlying causes

- Rheumatic valvular disease
- Congenital heart disease
- Mitral valve prolapse
- Degenerative heart disease

#### Microbiology of NVE

Approximately three quarters of infections are caused by **Streptococcus species** (*S viridans* and *S bovis*) and **enterococci**

**Staphylococcus species** cause 25% of cases and generally demonstrate a more aggressive acute course

### Prosthetic valve endocarditis (PVE)

#### Early PVE

Often caused by **S aureus** and is associated with **local abscess and fistula formation and valvular dehiscence**

#### Late PVE

Caused mainly by **Streptococci** and presents in a **subacute fashion** similar to NVE

#### Coagulase Negative Staphylococci (CNS)

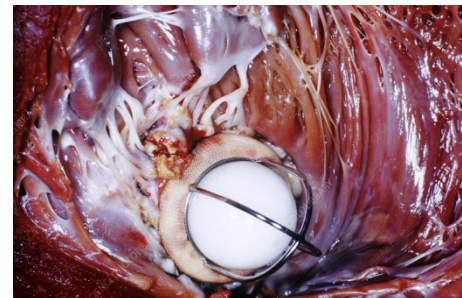
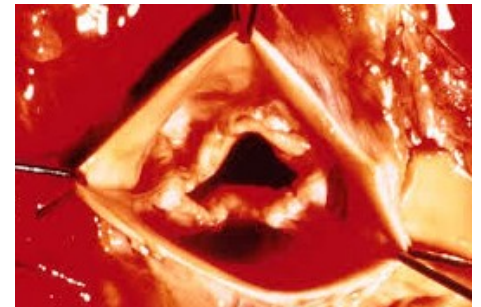
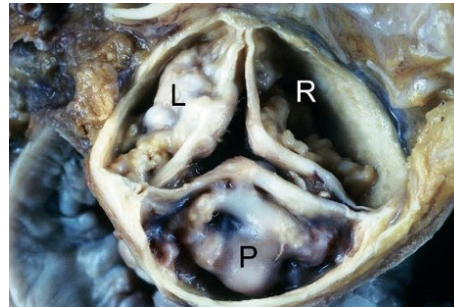
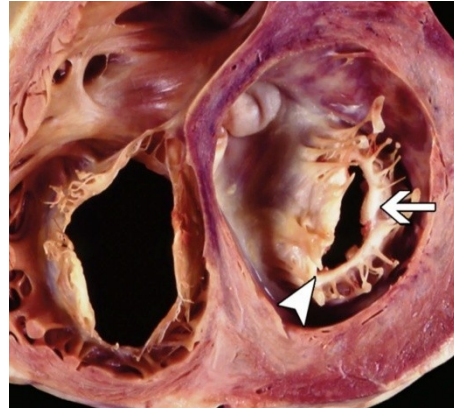
cause of PVE in 30% (17% of early PVE and 13% of late PVE)

#### Other organisms

*Corynebacterium*, Non-enterococcal streptococci, Fungi, *Legionella* and HACEK organisms cause the remaining cases

## Underlying heart disease

- Rheumatic heart disease
- Mitral valve prolapse
- Degenerative calcific valvular stenosis
- Bicuspid aortic valve
- Artificial (prosthetic) valves
- Implanted devices (pacemakers and defibrillators)
- Congenital heart disease
- Prior infective endocarditis



## Injection drug use-infective endocarditis (IDU-IE)

No previous history of heart disease or murmur on admission in the majority (70%) of the cases

Pulmonary manifestations may be prominent

- 30% have pleuritic chest pain

- 75% demonstrate chest radiographic abnormalities

### Staphylococcus aureus

- Most common organism (50% of cases)

Streptococci (groups A, c and G) and enterococci and Gram-negative organisms (Pseudomonas HACEK) are involved less frequently



## Injection drug use-associated infective endocarditis (IDU-IE)

People who inject drugs have a **100-fold higher risk of infective endocarditis** compared with the general population

Incidence of injection drug use-associated infective endocarditis (IDU-IE) has increased with the **opioid epidemic and growing number of people who inject drugs**

IDU-IE patients are typically much **younger than patients with non-IDU-IE** and have lower prevalence of other medical conditions

# Injection drug use-associated infective endocarditis (IDU-IE)

## Short-term outcome

IDU-IE compared with non-IDU-IE achieve **similar or better treatment outcomes** in the short term, particularly with surgical interventions.

## Long-term outcome

Notably **poorer** compared with non-IDU-IE patients

- More complex hospital courses

- Prolonged hospitalizations

- Higher 30-day readmissions

- Increased occurrences of reoperation, reinfection and increased rates of long-term mortality

## Healthcare-associated infective endocarditis

### Endocarditis associated with therapeutic modalities involving intravascular devices

#### Patients tend to have significant comorbidities

Intravenous drug use, chronic kidney disease (dialysis patients), chronic liver disease, malignancy, advanced age, corticosteroid use, poorly controlled diabetes, indwelling line for venous access, immunocompromised state

#### Mortality rate is high

Gram-positive cocci (*S aureus*, CNS, enterococci, non-enterococcal streptococci) are the most common pathogens of HCIE



## Fungal endocarditis

Found in **IV drug users and intensive care unit patients** who receive broad-spectrum antibiotics

**Blood cultures** may be negative

**Microscopic examination** of vegetations or large emboli may detect the organism

***Candida auris*** is particularly concerning since most infections are recognized in healthcare facilities and can rapidly spread throughout and between healthcare facilities

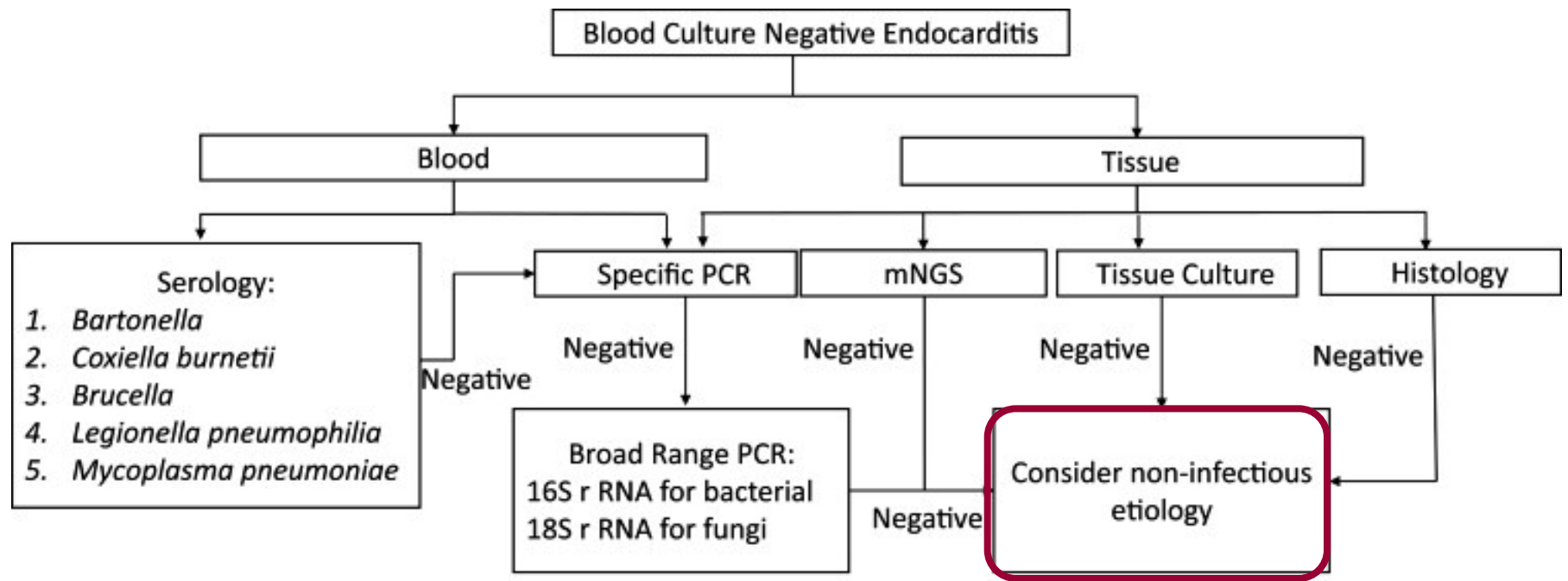
*Candida auris* is usually **resistant to many antifungals**

## Culture negative endocarditis

**No** organisms can be found in 10% of cases

Possible reasons for culture negative endocarditis:

- **Inappropriate institution antibiotics** prior to obtaining adequately drawn blood cultures
  
- **Laboratory difficulties** in isolating organisms  
Bartonella, Tropheryma, Coxiella, Brucella,  
Mycoplasma, Legionella, Fungi
  
- **Deeply embedded organisms**
  
- **Incorrect diagnosis**



Diagnostic strategy for patients with blood culture-negative endocarditis (BCNE)

## Culture negative endocarditis

	Advantage	Disadvantage
<b>Culture</b>	Gold standard	Takes long time; difficult to culture fastidious bacteria
<b>Serology</b>	Inexpensive; <i>Coxiella burnetii</i> and <i>Bartonella</i> spp	Not available in certain countries; single serum sample can be inaccurate; false-positives due to IgM phase may persist for a longer period
<b>Histopathology</b>	Rapid; definite diagnosis; inexpensive	Low sensitivity if low burden of disease; low specificity; few identifiable pathogens
<b>PCR</b>	Rapid; able to detect multiple organisms; sensitivity in tissue higher than in blood sample	Sometimes requires more than one amplification; limited to a small portion of genome; difficulties in distinguishing individual pathogens in polymicrobial sample
<b>NGS</b>	Unbiased sampling; discovery of new or unexpected organisms; predict drug resistance; provides quantitative data	No clear database being cleared point out; human host background and should have depletion method; expensive; contamination sample with environmental species



## Laboratory diagnosis of infective endocarditis

**Three to five blood cultures** within 24 h may be needed to isolate the etiologic agent

**Identification** of the organism and its antimicrobial susceptibility is vital to guide bactericidal treatment

Blood cultures may require 3 to 4 weeks **incubation** for certain organisms

Some organisms such as *Aspergillus* species may **not produce positive cultures**

**Serological diagnosis** is required for *Coxiella burnetii* (Q fever) and *Chlamydia psittaci*

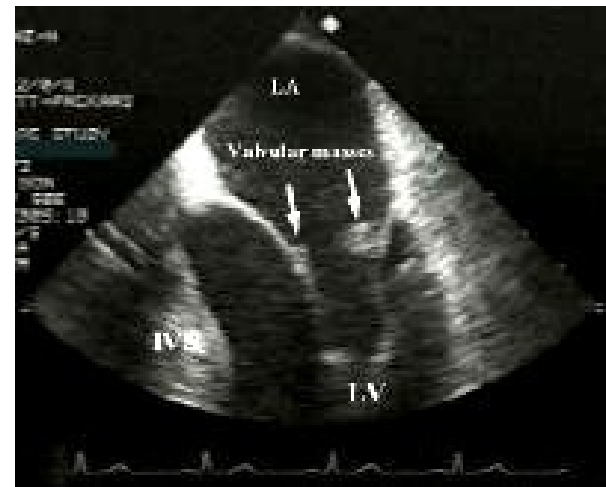
**Special culture media** are needed for *Legionella pneumophila*

## Imaging diagnosis of infective endocarditis

**Transthoracic echocardiography** detects vegetations in 50% of patients with endocarditis and may eliminate the need for more invasive procedures

**Trans-oesophageal echocardiography** detects vegetations in >90% of patients, including those with negative blood cultures

It can also detect **myocardial abscesses**



## Prognosis of infective endocarditis

Untreated, infective endocarditis is always **fatal**

**Right-sided endocarditis** responds to antimicrobial therapy and has a better prognosis than left-sided endocarditis

Mortality of **viridans streptococcus** is <10%, but is ~100% with **Aspergillus** after prosthetic valve surgery

**Cardiac surgery** is associated with **improved survival**

## Indication for Early Cardiac-Valve Surgery

```
graph TD; A[Indication for Early Cardiac-Valve Surgery] --> B[Heart failure]; A --> C[Prevention of systemic embolization]; A --> D[Uncontrolled infection]; B --> E[• Refractory pulmonary edema or cardiogenic shock due to aortic-valve or mitral-valve dysfunction, obstruction, fistula, or shunt  
• Aortic-valve or mitral-valve regurgitation or dysfunction with poorly compensated hemodynamic function]; C --> F[Aortic-valve or mitral-valve vegetation >10 mm, especially when accompanied by ≥1 embolic events while the patient is receiving appropriate therapy]; D --> G[• Fungal causative microorganism  
• Multidrug-resistant microorganism  
• Blood cultures that are persistently positive for an antibiotic-susceptible pathogen in a patient receiving appropriate antimicrobial therapy for 6 or 7 days despite adequate source control of other foci of infection  
• Paravalvular complications (e.g., abscess)];
```

### Heart failure

- Refractory pulmonary edema or cardiogenic shock due to aortic-valve or mitral-valve dysfunction, obstruction, fistula, or shunt
- Aortic-valve or mitral-valve regurgitation or dysfunction with poorly compensated hemodynamic function

### Prevention of systemic embolization

Aortic-valve or mitral-valve vegetation >10 mm, especially when accompanied by  $\geq 1$  embolic events while the patient is receiving appropriate therapy

### Uncontrolled infection

- Fungal causative microorganism
- Multidrug-resistant microorganism
- Blood cultures that are persistently positive for an antibiotic-susceptible pathogen in a patient receiving appropriate antimicrobial therapy for 6 or 7 days despite adequate source control of other foci of infection
- Paravalvular complications (e.g., abscess)



## Poor prognostic findings in infective endocarditis

- Heart failure
- Old age
- Multiple valve involvement
- Large vegetations
- Antimicrobial resistance
- Delay in therapy
- Prosthetic valve infections
- Major embolic events

## **Cause of death**

**Heart failure** (exacerbation of underlying heart disease or acute valve dysfunction)

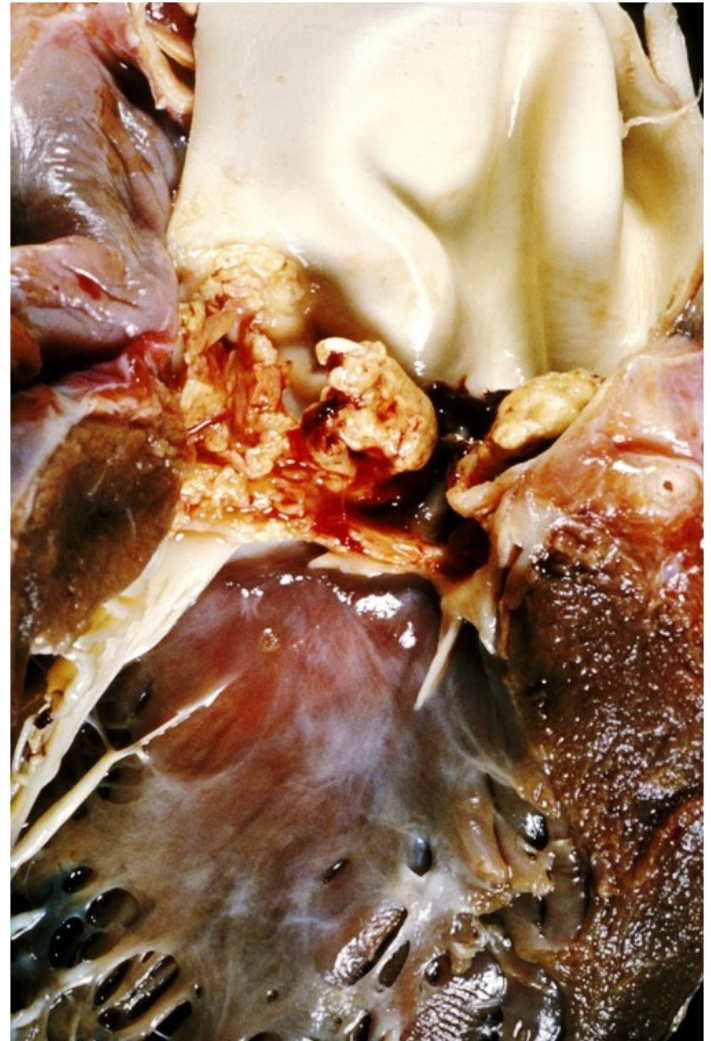
**Embolization** of vegetations to vital organs, producing infarction

**Ruptured** mycotic aneurysm

**Septic shock** in acute bacterial endocarditis

**Renal failure**

**Complications of cardiac surgery**



Current trends and future concerns  
**Antimicrobial resistance**

**Changing epidemiologic trends**

Body piercing

Excessive alcohol consumption

Intravenous drugs use

Other

**Children** with congenital heart defects

**Nosocomial infection** can result from invasive procedures such as catheterisation

Clinical, Microbiological, and Imaging  
Characteristics of Infective Endocarditis in  
Latin America: A Systematic Review  
Urina-Jassir, et al. International Journal of  
Infectious Diseases 2022



Forty-four studies were included

Two thirds were **male** (68.5%)

Predisposing condition including **valve disease** (24.3%) or **prosthetic valve** (23.4%)

Clinical manifestations included **fever** (83.9%), **malaise** (63.2%) or **heart murmur** (57.7%)

36.4% and 27.1% developed **heart failure** or **embolism**, respectively

Blood cultures were negative in 23.9%

*S. aureus* (18.6%) and the viridans group streptococci (17.8%) were the most common isolates

Two thirds were **native valve IE** (67.3%) affecting mainly **left-sided valves**

Echocardiographic findings included **vegetations** (84.3%) and **regurgitation** (75.9%)

In-hospital mortality was 25.1%



## Percentage of Infectious Endocarditis Cases in the Population

80%  
gram-positive

**Staphylococci**  
35-40%

- *Staphylococcus aureus*
- Coagulase-negative staphylococci

**Streptococci and Enterococci**  
40-45%

- Oral streptococci: 20%
  - *Streptococcus gallolyticus*: 10-15%
- Enterococci: 10%

20%

**HACEK**  
(haemophilus, aggregatibacter, cardiobacterium, *Eikenella corrodens*, kingella) microorganisms

5 %

- *Candida* species 2%
- Other\* 0%
- Polymicrobial ( $\geq 2$  microorganisms) 8%
- No microorganism identified 2%

Echocardiogram		
Echocardiogram	Number of studies	n/N (%)
Vegetation	25	2333/2767 (84.3%)
Valvular regurgitation	11	1050/1383 (75.9%)
Abscess	18	332/2614 (12.7%)
Rupture or perforation	9	168/1426 (11.8%)
Dehiscence	5	44/1112 (4.0%)

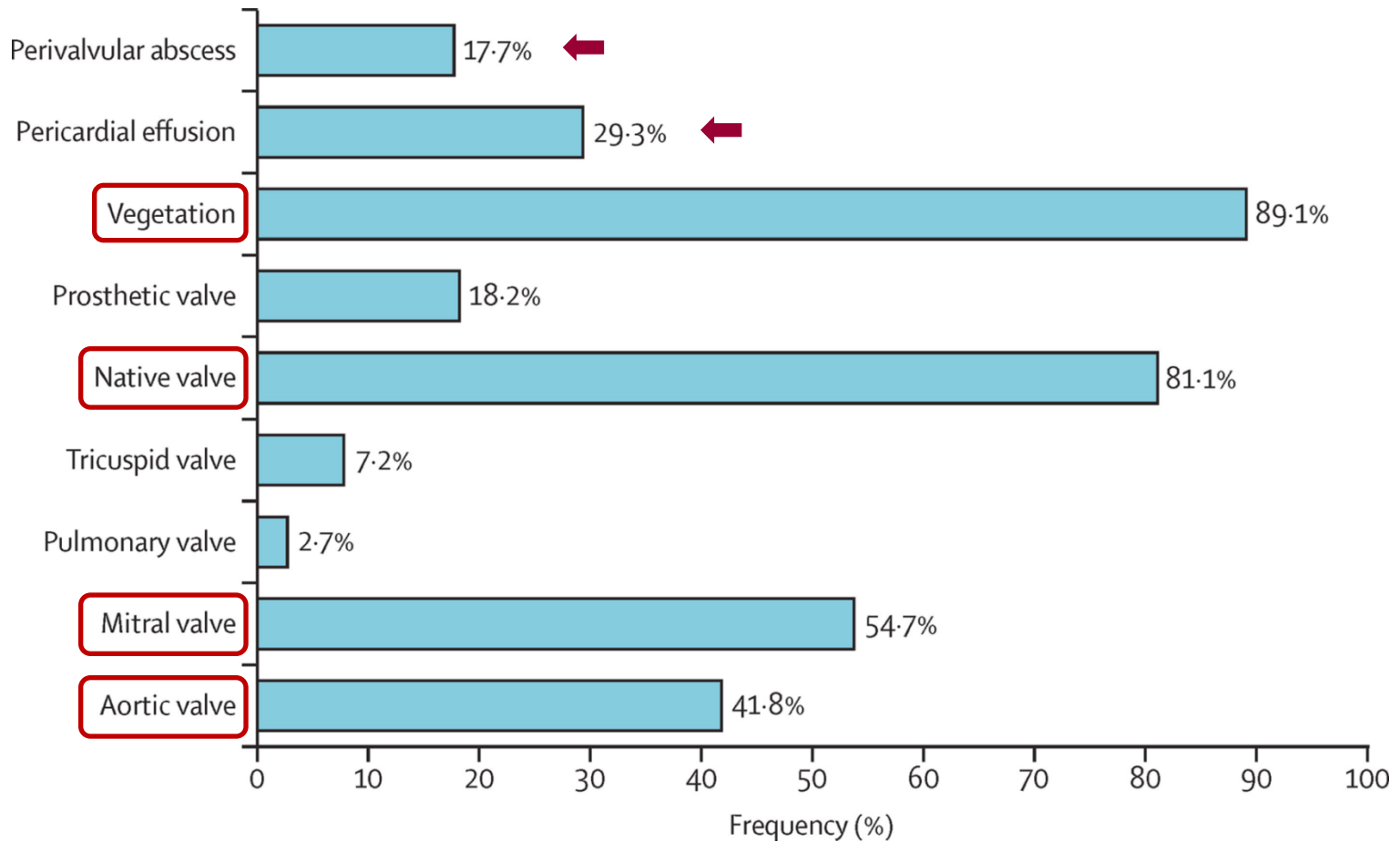
**n** is the total number of cases with that variable, **N** is the total number of cases of the studies reporting that variable

## Location of endocarditis

	Number of studies	n/N(%)
<b>Native valve</b>		
<b>Aortic</b>	<b>19</b>	<b>575/2050 (28.1%)</b>
<b>Mitral</b>	<b>19</b>	<b>564/2092 (27.0%)</b>
Tricuspid	15	123/1928 (6.4%)
Pulmonary	6	13/1555 (0.8%)
<b>Mitral + aortic</b>	<b>10</b>	<b>117/1489 (7.9%)</b>
Other combined	3	6/113 (5.3%)
<b>Prosthetic valve</b>		
<b>Aortic</b>	<b>9</b>	<b>171/1272 (13.4%)</b>
<b>Mitral</b>	<b>9</b>	<b>110/1230 (8.9%)</b>
Tricuspid	3	2/900 (0.2%)
Pulmonary	3	4/927 (0.4%)
Mitral + aortic	5	19/1095 (1.7%)
<b>Non-specified</b>		
<b>Aortic</b>	<b>11</b>	<b>519/1223 (42.4%)</b>
<b>Mitral</b>	<b>11</b>	<b>475/1223 (38.8%)</b>
Tricuspid	8	100/1080 (9.3%)
Pulmonary	3	8/582 (1.4%)
<b>Mitral + aortic</b>	<b>6</b>	<b>62/568 (10.9%)</b>
Other combined valves	1	6/71 (8.5%)
Unidentified/other	9	63/777 (8.1%)

n is the total number of cases with that variable, N is the total number of cases of the studies reporting that variable

Epidemiology of infective endocarditis in Africa  
Systematic review and meta-analysis  
Noubiap JJ, The Lancet 2022



Pooled distribution of echocardiographic features of infective endocarditis



## Summary of right sided endocarditis

5-10% of IE cases, usually IVDU related

Less severe with lower mortality (5%) and need for surgery (1%) compared to IVDU endocarditis occurring in **left sided BE** (28%, 15% respectively)

IVDU related infective endocarditis affect the **tricuspid valve** in 60 -70%, **aortic valve or mitral valves** in 20-30% and **multiple valves** in 5 - 10%

**Staph aureus** causes 70-90% of IVDU endocarditis